

August 27, 1998

Mr. Michael Bellot
U.S. Environmental Protection Agency
Water Management Division
Region V
77 West Jackson Boulevard
Chicago, IL 60604-3590

Re: Waukegan Manufactured Gas and Coke Plant Site

Dear Mr. Bellot:

The attached tables and figures summarize the results from the June 30-July 2, 1998, surface water sampling near the WCP site. The sampling was conducted in accordance with the Work Plan transmitted to you on June 5, 1998, with the addition of the SW-6N sampling location.

Sampling Data

The sampling data are summarized, both field and laboratory, in Tables 1 and 2. Quality control sample data in Table 3. A separate summary of the field data is also attached, showing field observations and the order of sampling. Winds were 5–10 miles per hour (mph) from the northwest on June 30 and July 1 when the transects and the SW-1, SW-2, and SW-4 locations were sampled. Winds were westerly at about 10 mph on July 2 when the remaining lake samples and the harbor samples were collected.

The laboratory data are presented on figures showing the sampling locations. Figures 1 through 3 show the sample locations in the harbor and along the lake front for ammonia, arsenic, and total phenols. Figures 4 and 5 show the surface water velocity measurements along the lake front and in the harbor (Figure 4) and at the transect sampling area (Figure 5). Figures 6 through 12 show sampling results in detail for the transect area and harbor. The transect area figures include the 1996–1997 groundwater data and groundwater contours from the FS.

Quality Control

The ammonia results reported here are a reanalysis of the samples. The method blanks with the initial analysis were reported to have 0.020 mg/L ammonia. The laboratory reanalyzed the ammonia samples within the holding time. No other data quality control issues were reported.

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Data Analysis

Water quality standards for comparison with the sample data are included in Tables 1 and 2. No harbor or breakwater area samples exceeded Lake Michigan Basin water quality standards. No near-shore samples from Lake Michigan exceeded the open waters standards for Lake Michigan for arsenic or phenols.

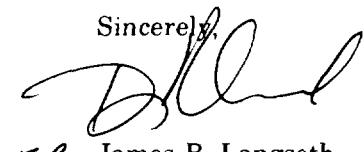
Exceedances of the open waters standard for ammonia (0.020 mg/L) were reported for some of the transect samples for each of the three transects. The average ammonia concentration for the 30 transect samples was 0.027 mg/L (using 0.005 mg/L, one-half the detection limit, for nondetects), only slightly above the open waters standard. The open waters standard is based on the background ammonia concentration in the open waters of Lake Michigan and is not related to protection of human health or aquatic life.

Next Sampling Event

We propose to repeat the sampling program during the week of September 14–18, weather permitting.

Please let me know if you have any comments on this data or adjustments to the sampling program.

Sincerely,



fol James R. Langseth

JRL/lah

Enclosure

c: Jerry Willman, IEPA
Bob Mosher, IEPA
Bill Andrae, CH2M Hill
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Dr. Bruce Rittmann, Northwestern Univ. (NSG/GM)
Dr. Charles Gantzer, GEES (NSG/GM)
Dr. John Fletcher, Univ. of Oklahoma (NSG/GM)
Shahrokh Rouhani, NewFields (NSG/GM)

Table 1
1998 Surface Water Samples
Lake Michigan Near-Shore Open Waters
Water Quality Data

Lake Michigan Open Waters Water Quality							
Standards	SW-2NA	SW-2NB	SW-3NA	SW-3NB	SW-4NA	SW-4NB	SW-5NA
	07/01/1998	07/01/1998	07/02/1998	07/02/1998	07/01/1998	07/01/1998	07/02/1998
Depth (ft)	4.1	4.1	2.1	2.1	9.3	9.3	6.5
Ammonia Nitrogen (mg/L)	0.02	0.01	0.01 U				
Arsenic, Total (mg/L)	0.05	0.0020 U					
Arsenic, dissolved (mg/L)		0.0020 U					
Phenol 4AAP (mg/L)	0.001	0.01 U					
I - nol (mg/L)		0.010 U					
m-Cresol (mg/L)	--	--	--	--	--	--	--
o-Cresol (mg/L)		0.010 U					
p-Cresol (mg/L)		0.010 U					
2,4-Dimethylphenol (mg/L)	0.45	0.010 U					
Benzene (mg/L)	0.012	0.001 U					
Temperature (degrees C)	20.4	20.7	17.5	17.7	19.4	19.2	16.1
Dissolved oxygen (mg/L)	9.30	9.24	10.15	10.10	9.52	9.53	8.07
pH (standard units)	7.86	7.97	7.89	7.97	7.99	8.06	8.07
Redox (oxidation potential, mV)	65	59	69	63	63	60	59
Specific Conductance (umhos/cm @ 25oC)	291	291	288	289	290	276	287

Table 1 (cont.)
1998 Surface Water Samples
Lake Michigan Near-Shore Open Waters
Water Quality Data

Lake Michigan Open Waters Water Quality		Standards	SW-5NB	SW-6NA	SW-6NB	SW-1SA	SW-1SB
			07/02/1998	07/02/1998	07/02/1998	07/02/1998	07/02/1998
Depth (ft)			6.5	1.8	1.8	5.1	5.1
Ammonia Nitrogen (mg/L)	0.02		0.01 U				
Arsenic, Total (mg/L)	0.05		0.0020 U				
Arsenic, dissolved (mg/L)			0.0020 U				
Phenol tAAP (mg/L)	0.001		0.01 U				
o-I (mg/L)			0.010 U				
m-Cresol (mg/L)	--	--	--	--	--	--	--
o-Cresol (mg/L)			0.010 U				
p-Cresol (mg/L)			0.010 U				
2,4-Dimethylphenol (mg/L)	0.45		0.010 U				
Benzene (mg/L)	0.012		0.001 U				
Temperature (degrees C)			16.6	20.5	21.3	18.7	18.4
Dissolved oxygen (mg/L)			8.15	9.01	8.87	8.94	9.13
pH (standard units)			8.15	7.86	8.04	7.62	7.77
Redox (oxidation potential, mV)			54	66	56	107	80
Specific Conductance (umhos/cm @ 25oC)			288	297	296	290	288

Table 1 (cont.)
1998 Surface Water Samples
Lake Michigan Near-Shore Open Waters
Water Quality Data

Lake Michigan Open Waters Water Quality		Standards	SWT1-50A	SWT1-50B	SWT1-100A	SWT1-100B	SWT1-150A	SWT1-150B	SWT1-200A
			06/30/1998	06/30/1998	06/30/1998	06/30/1998	06/30/1998	06/30/1998	06/30/1998
Depth (ft)			2.6	2.6	3.8	3.8	3.9	3.9	3.2
Ammonia Nitrogen (mg/L)	0.02	0.09	0.03	0.02	0.02	0.02	0.02	0.02	0.01 U
Arsenic, Total (mg/L)	0.05	0.0038	0.0029	0.0020 U	0.0022	0.0020 U	0.0020 U	0.0020 U	0.0020 U
Arsenic, dissolved (mg/L)		0.0024	0.0024	0.0020 U	0.0021	0.0020 U	0.0020 U	0.0020 U	0.0020 U
p-Tolyl 4AAP (mg/L)	0.001	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
m-Cresol (mg/L)		0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
o-Cresol (mg/L)	--	--	--	--	--	--	--	--	--
p-Cresol (mg/L)		0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
2,4-Dimethylphenol (mg/L)	0.45	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzene (mg/L)	0.012	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Temperature (degrees C)		14.0	14.0	12.0	12.5	12.3	12.9	12.6	
Dissolved oxygen (mg/L)	11.09	11.20	11.21	11.57	11.40	11.31	11.43		
pH (standard units)	7.62	7.74	7.41	7.54	7.64	7.72	7.71		
Redox (oxidation potential, mV)	62	54	76	68	65	61	63		
Specific Conductance (umhos/cm @ 25oC)	300	299	292	293	291	292	288		

Table 1 (cont.)
1998 Surface Water Samples
Lake Michigan Near-Shore Open Waters
Water Quality Data

Lake Michigan Open Waters Water Quality		Standards	SWT1-200B	SWT1-250A	SWT1-250B	SWT2-50A	SWT2-50B	SWT2-100A	SWT2-100B
			06/30/1998	06/30/1998	06/30/1998	06/30/1998	06/30/1998	06/30/1998	06/30/1998
Depth (ft)			3.2	6.1	6.1	2.7	2.7	2.5	2.5
Ammonia Nitrogen (mg/L)	0.02		0.01	0.01	0.01 U	0.09	0.02	0.02	0.03
Arsenic, Total (mg/L)	0.05		0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0021	0.0020 U	0.0020 U
Arsenic, dissolved (mg/L)			0.0020 U						
Phenol 4AAP (mg/L)	0.001		0.01 U						
o-Cresol (mg/L)			0.010 U						
m-Cresol (mg/L)	--	--	--	--	--	--	--	--	--
o-Cresol (mg/L)			0.010 U						
p-Cresol (mg/L)			0.010 U						
2,4-Dimethylphenol (mg/L)	0.45		0.010 U						
Benzene (mg/L)	0.012		0.001 U						
Temperature (degrees C)			13.2	12.7	13.0	15.1	14.6	13.8	14.0
Dissolved oxygen (mg/L)			11.40	11.42	11.41	11.15	11.09	10.80	11.03
pH (standard units)			7.84	7.79	7.86	7.81	8.22	7.80	7.75
Redox (oxidation potential, mV)			54	60	55	58	62	62	64
Specific Conductance (umhos/cm @ 25oC)			285	286	286	294	292	291	284

Table 1 (cont.)
1998 Surface Water Samples
Lake Michigan Near-Shore Open Waters
Water Quality Data

	Lake Michigan Open Waters Water Quality	Standards	SWT2-150A	SWT2-150B	SWT2-200A	SWT2-200B	SWT2-250A	SWT2-250B	SWT3-50A
			06/30/1998	06/30/1998	06/30/1998	06/30/1998	07/01/1998	07/01/1998	07/01/1998
Depth (ft)			2.8	2.8	3.3	3.3	5.2	5.2	2.7
Ammonia Nitrogen (mg/L)	0.02	0.03	0.06	0.01 U	0.07	0.01 U	0.08	0.02	
Arsenic, Total (mg/L)	0.05	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0023	
Arsenic, dissolved (mg/L)		0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	
Phenol 4AAP (mg/L)	0.001	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	
tol (mg/L)		0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	
m-Cresol (mg/L)	--	--	--	--	--	--	--	--	
o-Cresol (mg/L)		0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	
p-Cresol (mg/L)		0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	
2,4-Dimethylphenol (mg/L)	0.45	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	
Benzene (mg/L)	0.012	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	
Temperature (degrees C)		13.9	13.4	14.8	14.0	17.7	17.8	18.3	
Dissolved oxygen (mg/L)	10.57	11.13	10.78	11.07	9.77	9.82	9.52		
pH (standard units)	7.78	8.04	7.77	7.83	7.97	7.73	7.83		
Redox (oxidation potential, mV)	65	64	65	65	57	79	61		
Specific Conductance (umhos/cm @ 25oC)	289	288	290	289	288	283	301		

Table 1 (cont.)
1998 Surface Water Samples
Lake Michigan Near-Shore Open Waters
Water Quality Data

Lake Michigan Open Waters Water Quality		Standards	SWT3-50B	SWT3-100A	SWT3-100B	SWT3-150A	SWT3-150B	SWT3-200A	SWT3-200B
			07/01/1998	07/01/1998	07/01/1998	07/01/1998	07/01/1998	07/01/1998	07/01/1998
Depth (ft)			2.7	3.9	3.9	3.5	3.5	3.7	3.7
Ammonia Nitrogen (mg/L)	0.02	0.04	0.01 U	0.02	0.02	0.05	0.01 U	0.01	
Arsenic, Total (mg/L)	0.05	0.0020 U	0.0020 U	0.0020 U	0.0023	0.0020 U	0.0020 U	0.0020 U	
Arsenic, dissolved (mg/L)		0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	
Phenol 4AAP (mg/L)	0.001	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	
Iodo (mg/L)		0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	
m-Cresol (mg/L)	--	--	--	--	--	--	--	--	
o-Cresol (mg/L)		0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	
p-Cresol (mg/L)		0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	
2,4-Dimethylphenol (mg/L)	0.45	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	
Benzene (mg/L)	0.012	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	
Temperature (degrees C)		18.6	18.3	18.9	19.0	19.6	20.3	21.1	
Dissolved oxygen (mg/L)	9.38	9.68	9.60	9.38	9.35	9.35	9.30		
pH (standard units)	7.83	7.82	8.02	8.04	8.06	8.00	8.10		
Redox (oxidation potential, mV)	62	62	49	48	47	53	47		
Specific Conductance (umhos/cm @ 25oC)	260	284	284	301	296	293	285		

Table 1 (cont.)
1998 Surface Water Samples
Lake Michigan Near-Shore Open Waters
Water Quality Data

Lake Michigan Open Waters Water Quality		Standards	SWT3-250A	SWT3-250B
		-----	07/01/1998	07/01/1998
Depth (ft)		4.8	4.8	
Ammonia Nitrogen (mg/L)	0.02	0.01 U	0.01 U	
Arsenic, Total (mg/L)	0.05	0.0020 U	0.0020 U	
Arsenic, dissolved (mg/L)		0.0020 U	0.0020 U	
Phenol 4AAP (mg/L)	0.001	0.01 U	0.01 U	
oI (mg/L)		0.010 U	0.010 U	
m-Cresol (mg/L)	--	--	--	
o-Cresol (mg/L)		0.010 U	0.010 U	
p-Cresol (mg/L)		0.010 U	0.010 U	
2,4-Dimethylphenol (mg/L)	0.45	0.010 U	0.010 U	
Benzene (mg/L)	0.012	0.001 U	0.001 U	
Temperature (degrees C)		19.5	20.0	
Dissolved oxygen (mg/L)		9.72	7.08	
pH (standard units)		7.97	8.08	
Redox (oxidation potential, mV)		55	46	
Specific Conductance (umhos/cm @ 25oC)		287	284	

Table 2
1998 Surface Water Samples
Harbor and Breakwater Areas
Water Quality Data

Lake Michigan Basin Water Water Quality		Standards(1)	SW-1NA	SW-1NB	H-1A	H-1B
			07/01/1998	07/01/1998	07/02/1998	07/02/1998
Depth (ft)		4.7	4.7	18.0	18.0	
Ammonia Nitrogen (mg/L)	15	0.01 U	0.01	0.01 U	0.01 U	
Arsenic, Total (mg/L)	0.148	0.0020 U	0.0020 U	0.0020 U	0.0020 U	
Arsenic, dissolved (mg/L)		0.0020 U	0.0020 U	0.0020 U	0.0020 U	
Phenol 4AAP (mg/L) oI (mg/L)	0.1	0.01 U 0.010 U	0.01 U 0.010 U	0.01 U 0.010 U	0.03	
m-Cresol (mg/L)		--	--	--	--	
o-Cresol (mg/L)		0.010 U	0.010 U	0.010 U	0.010 U	
p-Cresol (mg/L)		0.010 U	0.010 U	0.010 U	0.010 U	
2,4-Dimethylphenol (mg/L)	8.7	0.010 U	0.010 U	0.010 U	0.010 U	
Benzene (mg/L)	0.31	0.001 U	0.00038 J	0.00073 J	0.001 U	
Temperature (degrees C)		19.3	19.1	17.1	15.6	
Dissolved oxygen (mg/L)		9.56	9.54	10.03	9.84	
pH (standard units)		7.95	8.12	7.82	7.95	
Redox (oxidation potential, mV)		59	57	68	67	
Specific Conductance (umhos/cm @ 25oC)		287	281	296	288	

Table 2 (cont.)
1998 Surface Water Samples
Harbor and Breakwater Areas
Water Quality Data

Lake Michigan Basin Water Water Quality Standards(1)	H-2A	H-2B	H-3A	H-3B
	07/02/1998	07/02/1998	07/02/1998	07/02/1998
Depth (ft)	25.0	25.0	21.0	21.0
Ammonia Nitrogen (mg/L)	15	0.05	0.01	0.05
Arsenic, Total (mg/L)	0.148	0.0020 U	0.0020 U	0.0020 U
Arsenic, dissolved (mg/L)		0.0020 U	0.0020 U	0.0020 U
Phenol 4AAP (mg/L) oI (mg/L)	0.1	0.05 0.010 U	0.01 U 0.010 U	0.01 U 0.010 U
m-Cresol (mg/L)	--	--	--	--
<i>o</i> -Cresol (mg/L)		0.010 U	0.010 U	0.010 U
<i>p</i> -Cresol (mg/L)		0.010 U	0.010 U	0.010 U
2,4-Dimethylphenol (mg/L)	8.7	0.010 U	0.010 U	0.010 U
Benzene (mg/L)	0.31	0.007	0.00034 J	0.010
Temperature (degrees C)		18.7	15.9	18.4
Dissolved oxygen (mg/L)		8.57	8.58	7.94
pH (standard units)		7.23	7.87	7.11
Redox (oxidation potential, mV)		71	72	69
Specific Conductance (umhos/cm @ 25oC)		296	288	297

Table 3
QC Samples
Duplicates

	SWT1-250B 06/30/1998 Sample	SWT1-250B 06/30/1998 Duplicate	RPD	SWT2-250B 07/01/1998 Sample	SWT2-250B 07/01/1998 Duplicate	RPD
Depth (ft)	6.1	--		5.2	--	
Ammonia Nitrogen (mg/L)	0.01 U	0.01 U		0.08	0.02	120
Arsenic, Total (mg/L)	0.0020 U	0.0020 U		0.0020 U	0.0020 U	
Arsenic, dissolved (mg/L)	0.0020 U	0.0020 U		0.0020 U	0.0020 U	
Phenol 4AAP (mg/L)	0.01 U	0.01 U		0.01 U	0.01 U	
oI (mg/L)	0.010 U	0.010 U		0.010 U	0.010 U	
m-Cresol (mg/L)	--	--		--	--	
o-Cresol (mg/L)	0.010 U	0.010 U		0.010 U	0.010 U	
p-Cresol (mg/L)	0.010 U	0.010 U		0.010 U	0.010 U	
2,4-Dimethylphenol (mg/L)	0.010 U	0.010 U		0.010 U	0.010 U	
Benzene (mg/L)	0.001 U	0.001 U		0.001 U	0.001 U	
Temperature (degrees C)	13.0	--		17.8	--	
Dissolved oxygen (mg/L)	11.41	--		9.82	--	
pH (standard units)	7.86	--		7.73	--	
Redox (oxidation potential, mV)	55	--		79	--	
Specific Conductance (umhos/cm @ 25oC)	286	--		283	--	

Table 3 (cont.)
 QC Samples
 Duplicates

	SWT3-250B 07/01/1998 Sample	SWT3-250B 07/01/1998 Duplicate	RPD	SW-5NA 07/02/1998 Sample	SW-5NA 07/02/1998 Duplicate	RPD
Depth (ft)	4.8	--		6.5	--	
Ammonia Nitrogen (mg/L)	0.01 U	0.04		0.01 U	0.01 U	
Arsenic, Total (mg/L)	0.0020 U	0.0020 U		0.0020 U	0.0020 U	
Arsenic, dissolved (mg/L)	0.0020 U	0.0020 U		0.0020 U	0.0020 U	
Phenol 4AAP (mg/L)	0.01 U	0.01 U		0.01 U	0.01 U	
F-ol (mg/L)	0.010 U	0.010 U		0.010 U	0.010 U	
m-Cresol (mg/L)	--	--		--	--	
o-Cresol (mg/L)	0.010 U	0.010 U		0.010 U	0.010 U	
p-Cresol (mg/L)	0.010 U	0.010 U		0.010 U	0.010 U	
2,4-Dimethylphenol (mg/L)	0.010 U	0.010 U		0.010 U	0.010 U	
Benzene (mg/L)	0.001 U	0.001 U		0.001 U	0.001 U	
Temperature (degrees C)	20.0	--		16.1	--	
Dissolved oxygen (mg/L)	7.08	--		8.07	--	
pH (standard units)	8.08	--		8.07	--	
Redox (oxidation potential, mV)	46	--		59	--	
Specific Conductance (umhos/cm @ 25oC)	284	--		287	--	

Table 3 (cont.)
 QC Samples
 Blanks

	Field Blank	Trip Blanks				Lab Blanks		
	07/02/1998	07/01/1998	07/02/1998	07/02/1998	07/02/1998	06/30/1998	06/30/1998	06/30/1998
Ammonia Nitrogen (mg/L)	0.01 U	--	--	--	--	--	--	--
Arsenic, Total (mg/L)	0.0020 U	--	--	--	0.0020 U	0.0020 U	0.0020 U	--
Arsenic, dissolved (mg/L)	0.0020 U	--	--	--	0.0020 U	0.0020 U	0.0020 U	--
Phenol 4AAP (mg/L)	0.01 U	--	--	--	0.01 U	0.01 U	0.01 U	0.01 U
Phenol (mg/L)	0.010 U	--	--	--	0.010 U	0.010 U	0.010 U	0.010 U
m Cresol (mg/L)	--	--	--	--	--	--	--	--
o -Cresol (mg/L)	0.010 U	--	--	--	0.010 U	0.010 U	0.010 U	0.010 U
p-Cresol (mg/L)	0.010 U	--	--	--	0.010 U	0.010 U	0.010 U	0.010 U
2,4-Dimethylphenol (mg/L)	0.010 U	--	--	--	0.010 U	0.010 U	0.010 U	0.010 U
Benzene (mg/L)	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U

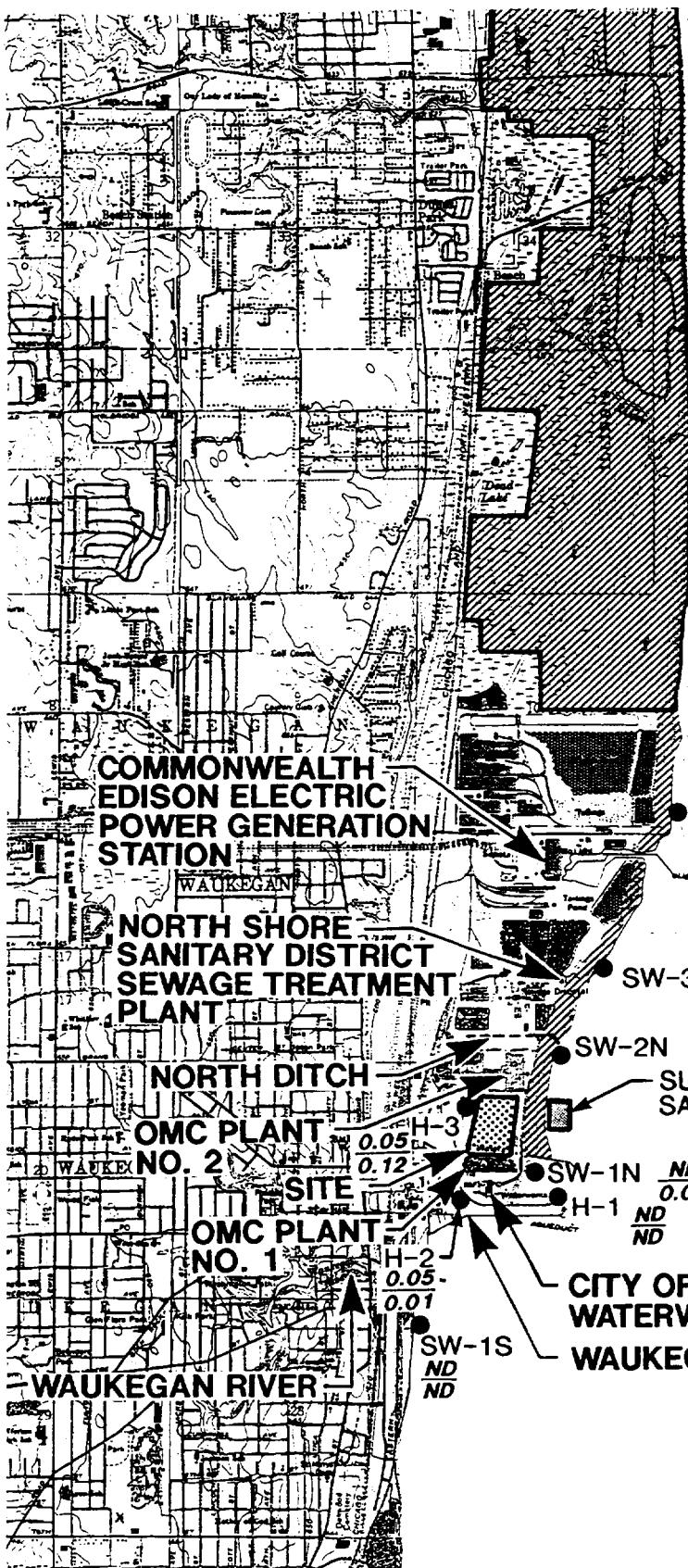
Table 3 (cont.)
 QC Samples
 Blanks

	Lab Blanks					
	07/01/1998	07/01/1998	07/02/1998	07/02/1998	07/02/1998	07/02/1998
Ammonia Nitrogen (mg/L)	0.01 U	--	0.01 U	--	--	--
Arsenic, Total (mg/L)	0.0020 U	--	0.0020 U	--	0.0020 U	--
Arsenic, dissolved (mg/L)	0.0020 U	--	0.0020 U	--	0.0020 U	--
Phenol 4AAP (mg/L)	0.01 U	0.01 U	0.01 U	--	0.01 U	0.01 U
Phenol (mg/L)	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	--
m-Cresol (mg/L)	--	--	--	--	--	--
sol (mg/L)	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	--
p-Cresol (mg/L)	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	--
2,4-Dimethylphenol (mg/L)	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	--
Benzene (mg/L)	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U

Data Qualifiers and Footnotes

Waukegan Lake & Harbor Water Quality Data

- Not analyzed.
- U Not detected
- j Reported value is less than the stated laboratory quantitation limit and is considered an estimated value.
- (1) Chronic standard for arsenic. Acute standard is 0.340 mg/L.



Note: Sample SW-6N Reported at $\frac{ND}{ND}$ Not Shown.

Source: Waukegan and Zion, Illinois Quadrangles, 7.5 Minute Series, 1980.

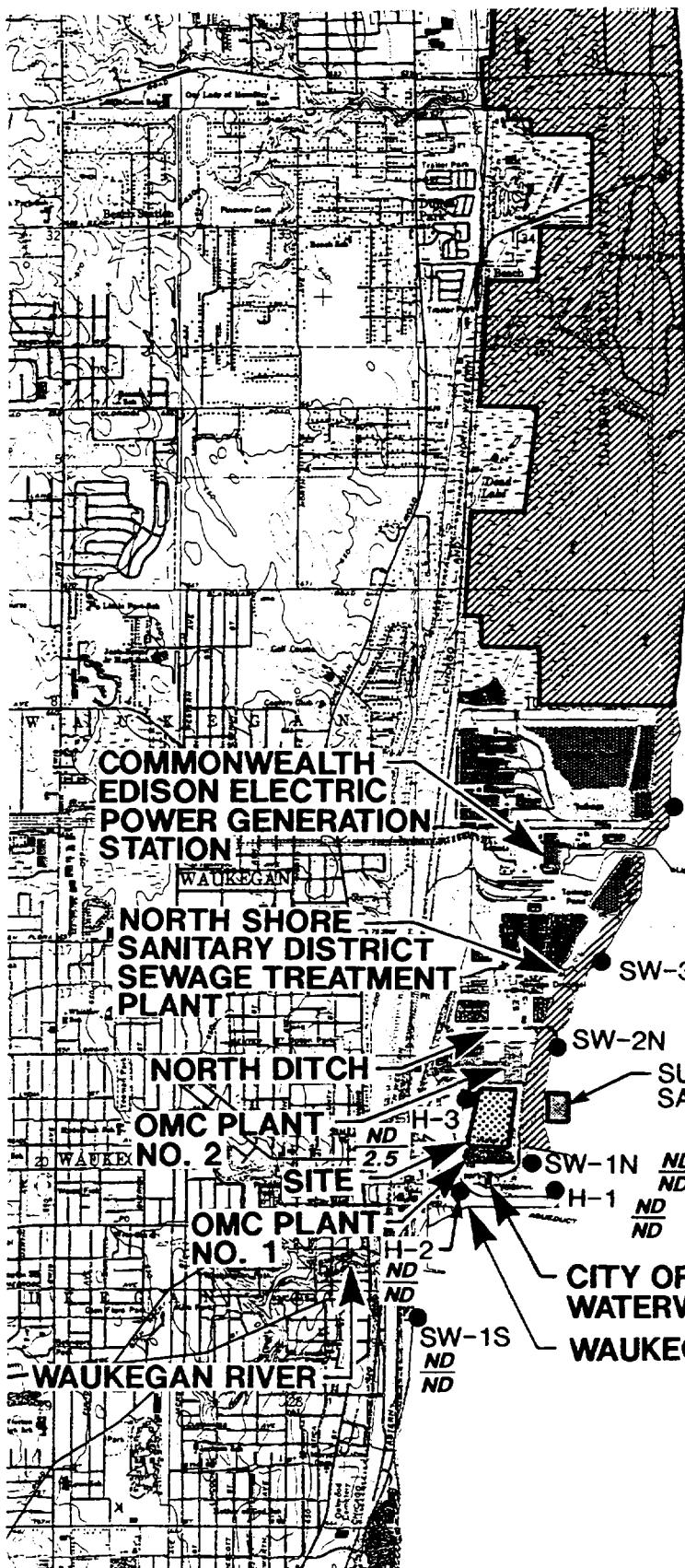
SW-1N • Surface Water Sample Location
July 1998
 $\frac{ND}{ND}$ 50cm from Bottom
 $\frac{ND}{ND}$ 2cm from Bottom



0 4000 8000
Scale in Feet

Figure 1

AMMONIA CONCENTRATIONS
IN SURFACE WATER
(Concentrations in mg/L)
Waukegan Manufactured Gas &
Coke Plant Site



Note: Sample SW-6N Reported at $\frac{ND}{ND}$ Not Shown.

Source: Waukegan and Zion, Illinois Quadrangles, 7.5 Minute Series, 1980.

SW-1N • Surface Water Sample Location July 1998
 $\frac{ND}{ND}$ 50cm from Bottom
 $\frac{ND}{ND}$ 2cm from Bottom

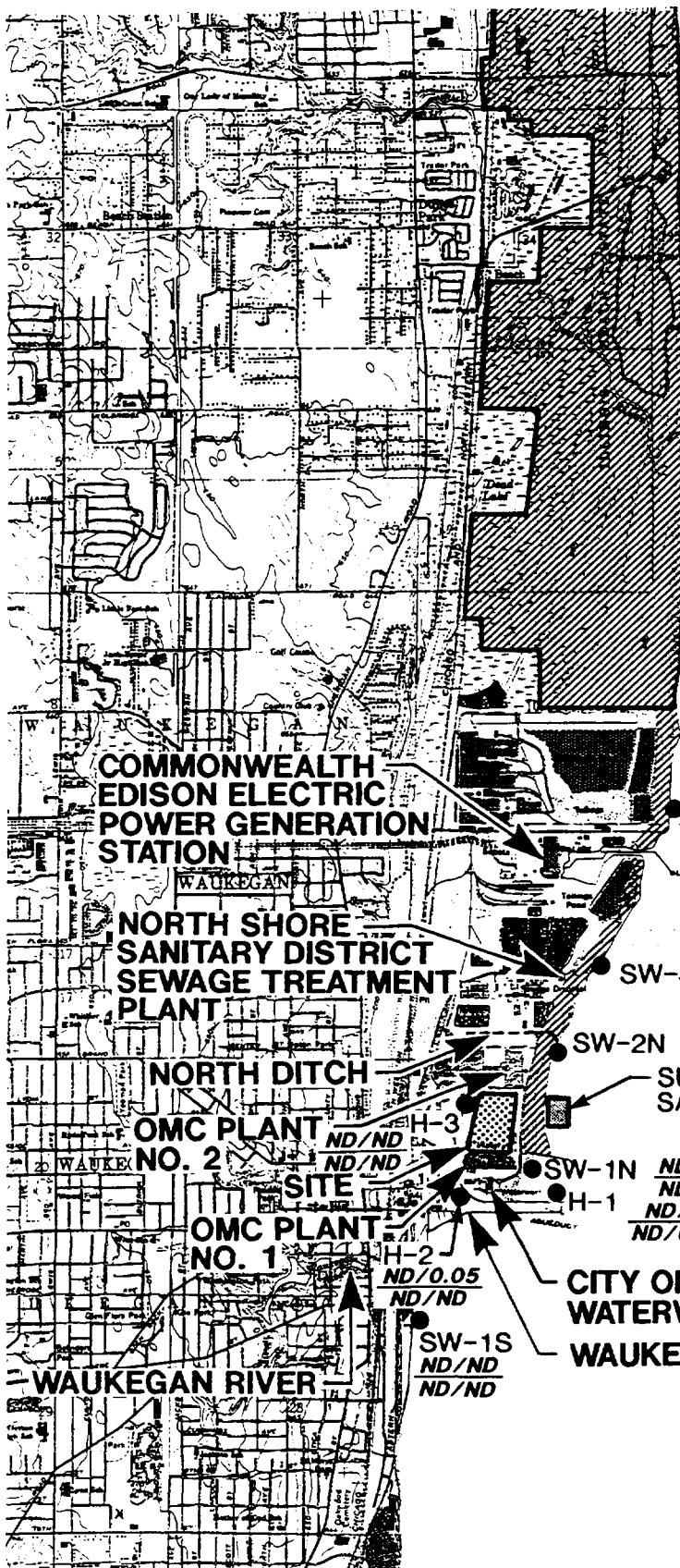


0 4000 8000
 Scale in Feet



Figure 2

ARSENIC CONCENTRATIONS
 IN SURFACE WATER
 (Concentrations in mg/L)
 Waukegan Manufactured Gas &
 Coke Plant Site



Note: Sample 6N Reported at ND/ND Not Shown.

ND/ND
ND/ND

ILLINOIS BEACH
STATE PARK

SW-4N ND/ND
ND/ND

SW-6N ND/ND
ND/ND

SW-3N ND/ND
ND/ND

SW-2N ND/ND
ND/ND

SURFACE WATER TRANSECT
SAMPLING AREA

SW-1N ND/ND
ND/ND
H-1 ND/ND
ND/0.03

CITY OF WAUKEGAN
WATERWORKS

WAUKEGAN HARBOR

Lake Michigan

SW-1N • Surface Water Sample
Location

July 1998

ND/ND ①/② 50cm from Bottom
ND/ND ①/② 2cm from Bottom

Note: ① Totals Determined by
Summation of Phenolic
Compounds by Method 8270.

② Totals Determined by
4 AAP Analytical Method.

Figure 3

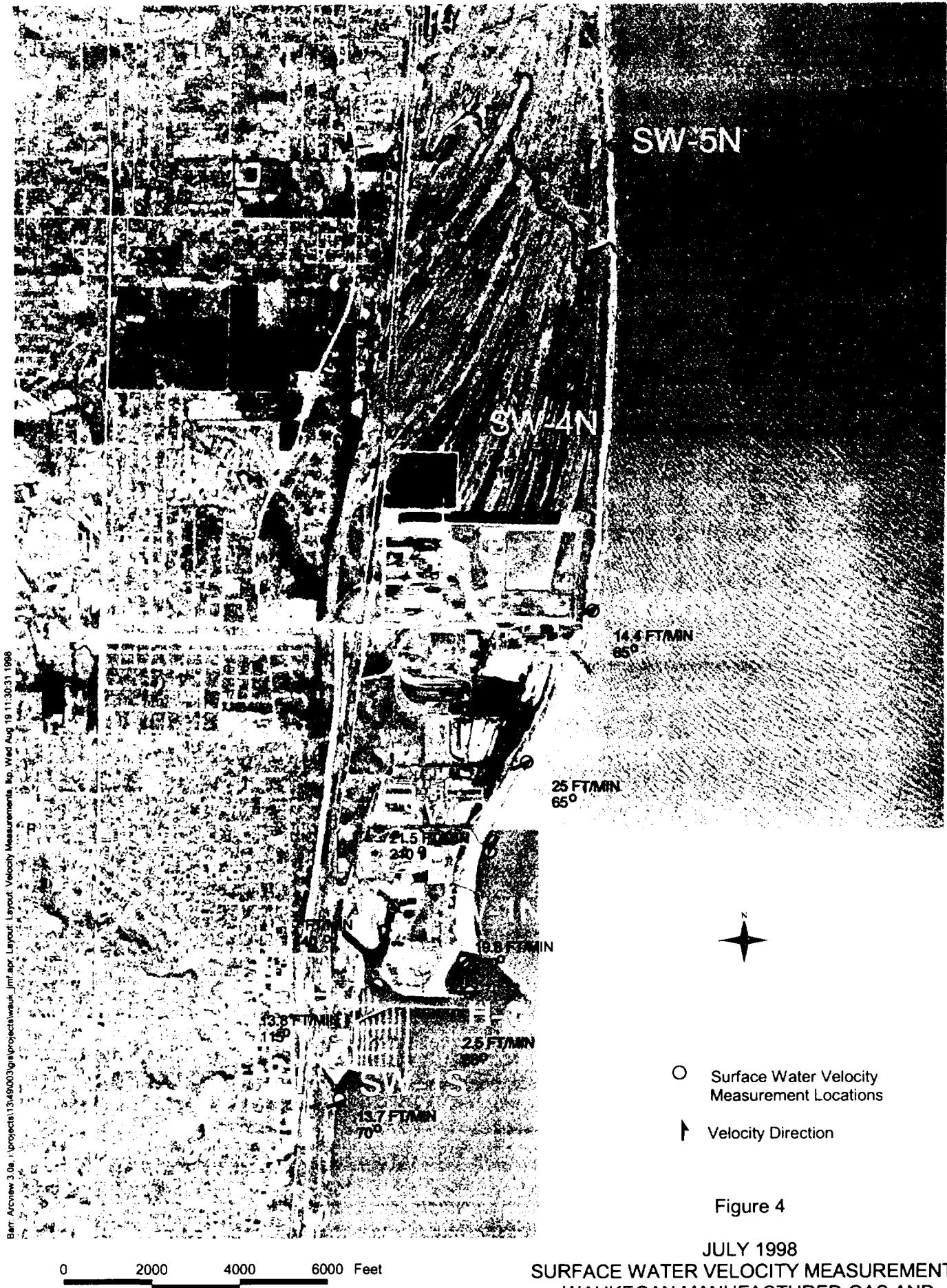
TOTAL PHENOLS CONCENTRATIONS
IN SURFACE WATER
(Concentrations in mg/L)
Waukegan Manufactured Gas &
Coke Plant Site

Source: Waukegan and Zion, Illinois Quadrangles, 7.5 Minute Series, 1980.



0 4000 8000
Scale in Feet





- Surface Water Velocity Measurement Locations
- ↗ Velocity Direction

Figure 4

JULY 1998
SURFACE WATER VELOCITY MEASUREMENTS
WAUKEGAN MANUFACTURED GAS AND
COKE PLANT SITE

1993 AERIAL PHOTO

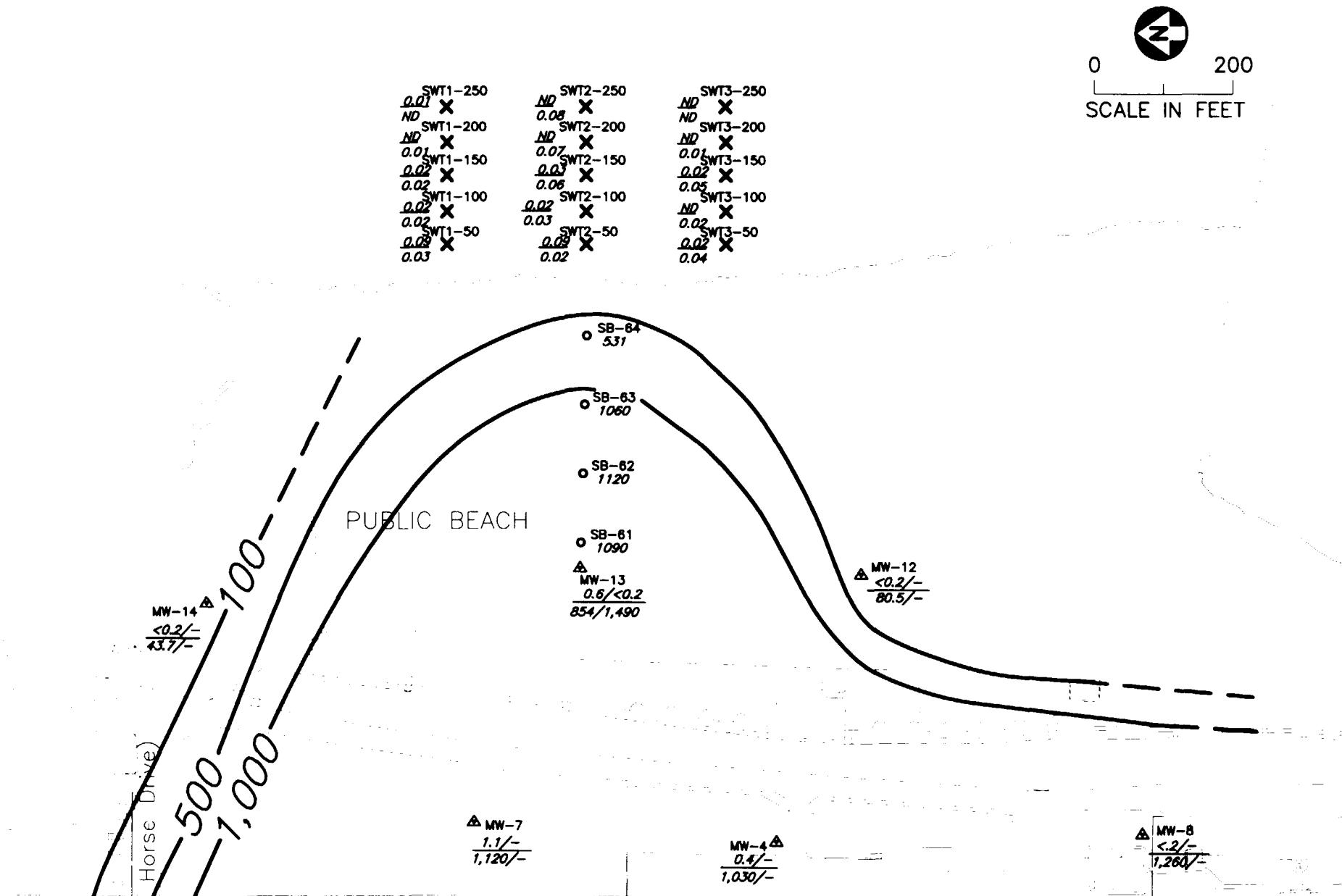
- Transect Sampling Point
- Velocity Direction
- Strandline - July 1, 1998

0 100 200 Feet



Figure 5

JULY 1998
SURFACE WATER VELOCITY MEASUREMENTS
WAUKEGAN MANUFACTURED GAS
AND COKE PLANT SITE



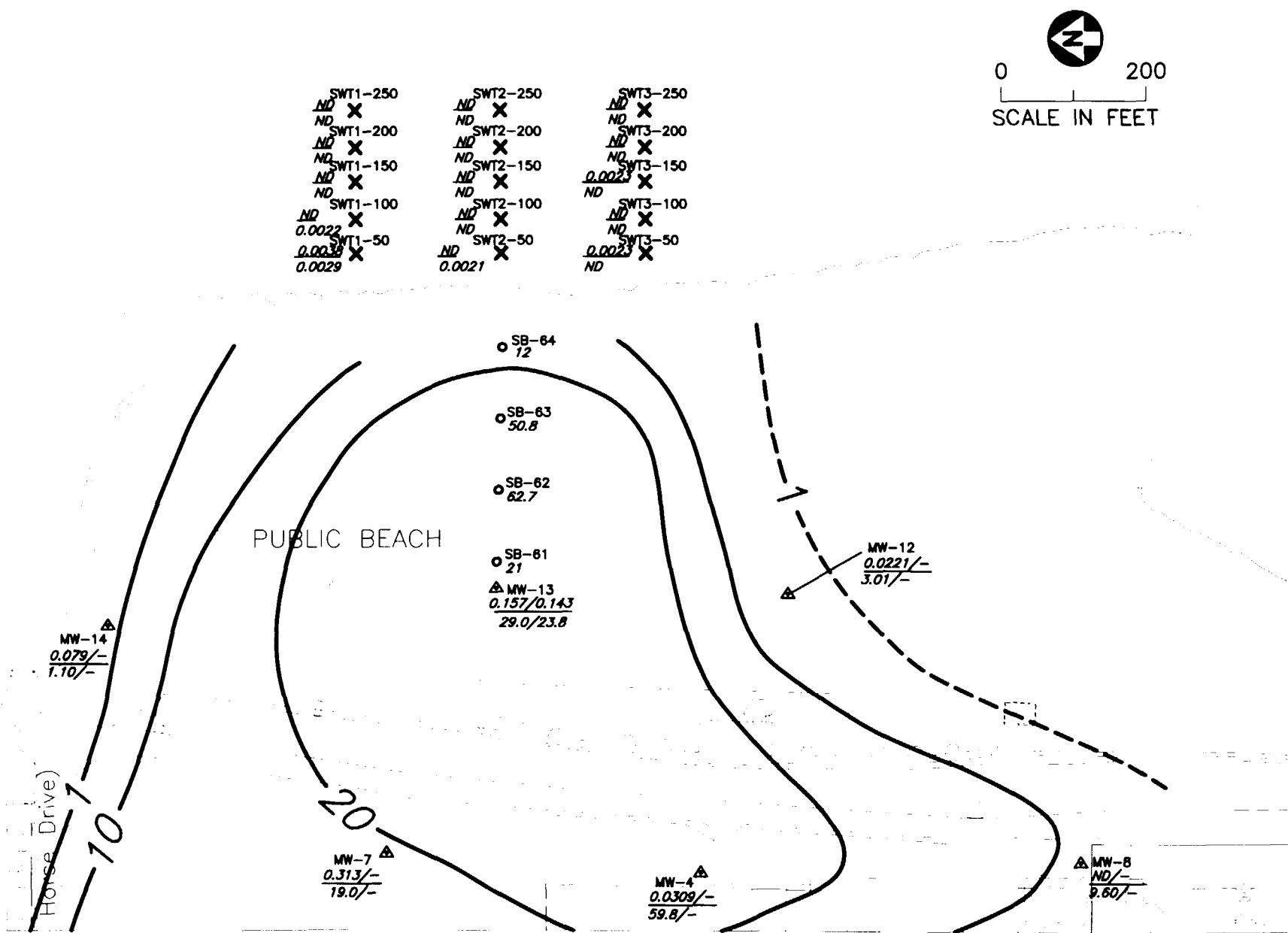
~~0.6/502~~ Top Of Aquifer 1996/1997
854/1,490 Base Of Aquifer 1996/1997

○ 1997 Hydropunch Sample
Base Of Aquifer Sample

✗ Surface Water Sample Location
July 1998

ND 50cm From Bottom
ND 2cm From Bottom

Figure 6
AMMONIA CONCENTRATIONS IN GROUNDWATER
AND SURFACE WATER
(Concentrations In mg/L)
Waukeaan Manufactured Gas And Coke Plant



\triangle Monitoring Well Nest
 $0.157/0.143$ Top Of Aquifer 1996/1997
 $29.0/23.8$ Base Of Aquifer 1996/1997

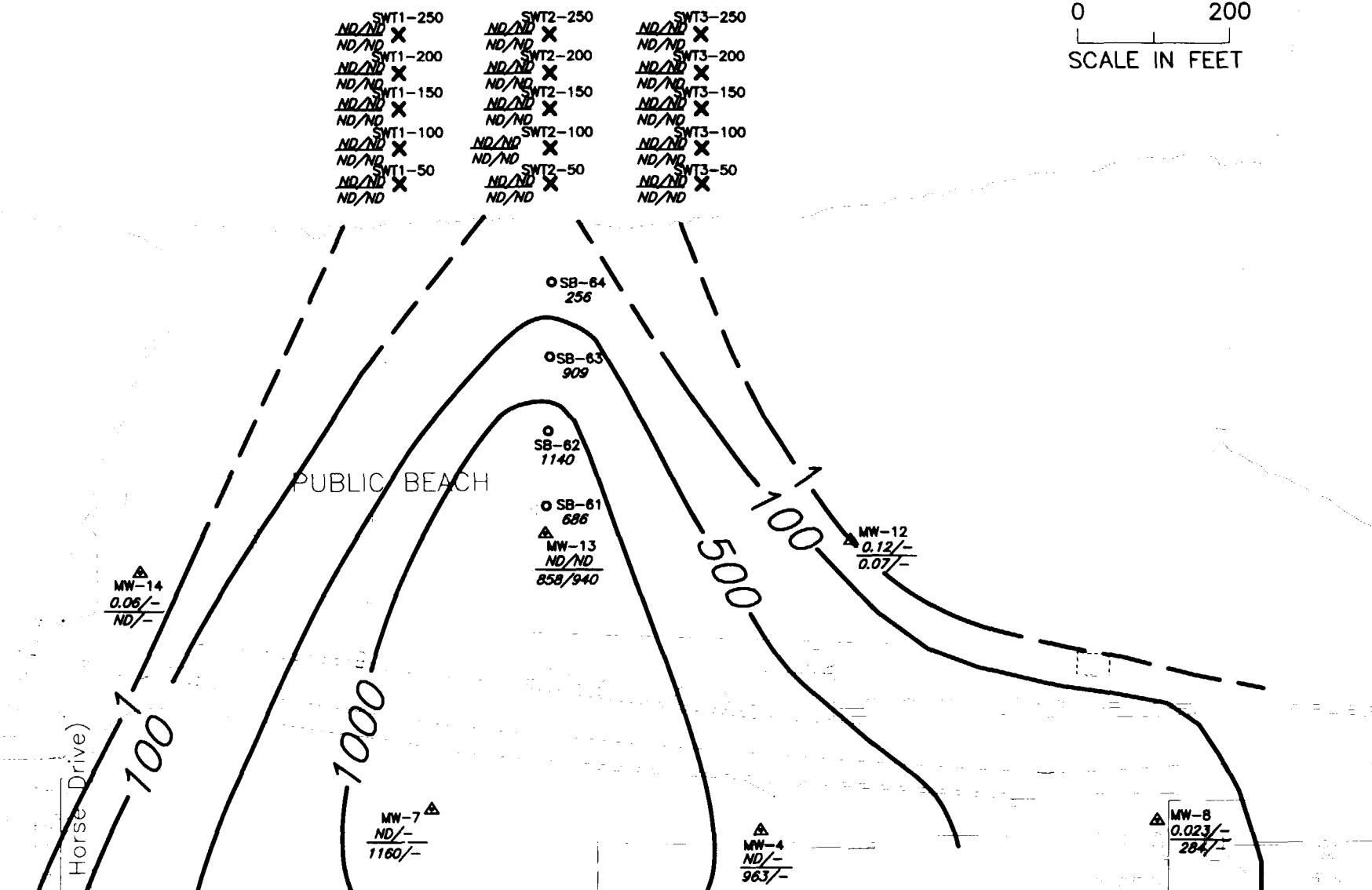
\times Surface Water Sample Location
 July 1998

ND 50cm From Bottom
 ND 2cm From Bottom

\circ 1997 Hydropunch Sample
 Base Of Aquifer Sample

NOTE: CONTOURS TAKEN FROM FS REPORT

Figure 7
 ARSENIC CONCENTRATIONS IN GROUNDWATER
 AND SURFACE WATER
 (Concentrations In mg/L)
 Waukegan Manufactured Gas And Coke Plant



Monitoring Well Nest

ND/ND Top Of Aquifer 1996/1997
858/940 Base Of Aquifer 1996/1997

1997 Hydropunch Sample
Base Of Aquifer Sample

Surface Water Sample Location
July 1998

ND ①/② 50cm From Bottom
ND ①/② 2cm From Bottom

NOTES:

- ① Totals Determined By Summation Of Phenolic Compounds By Method 8270.
- ② Totals Determined By 4AAP Analytical Method.

NOTE: CONTOURS TAKEN FROM FS REPORT

Figure 8

TOTAL PHENOLS CONCENTRATIONS IN GROUNDWATER AND SURFACE WATER
(Concentrations In mg/L)
Waukegan Manufactured Gas And Coke Plant

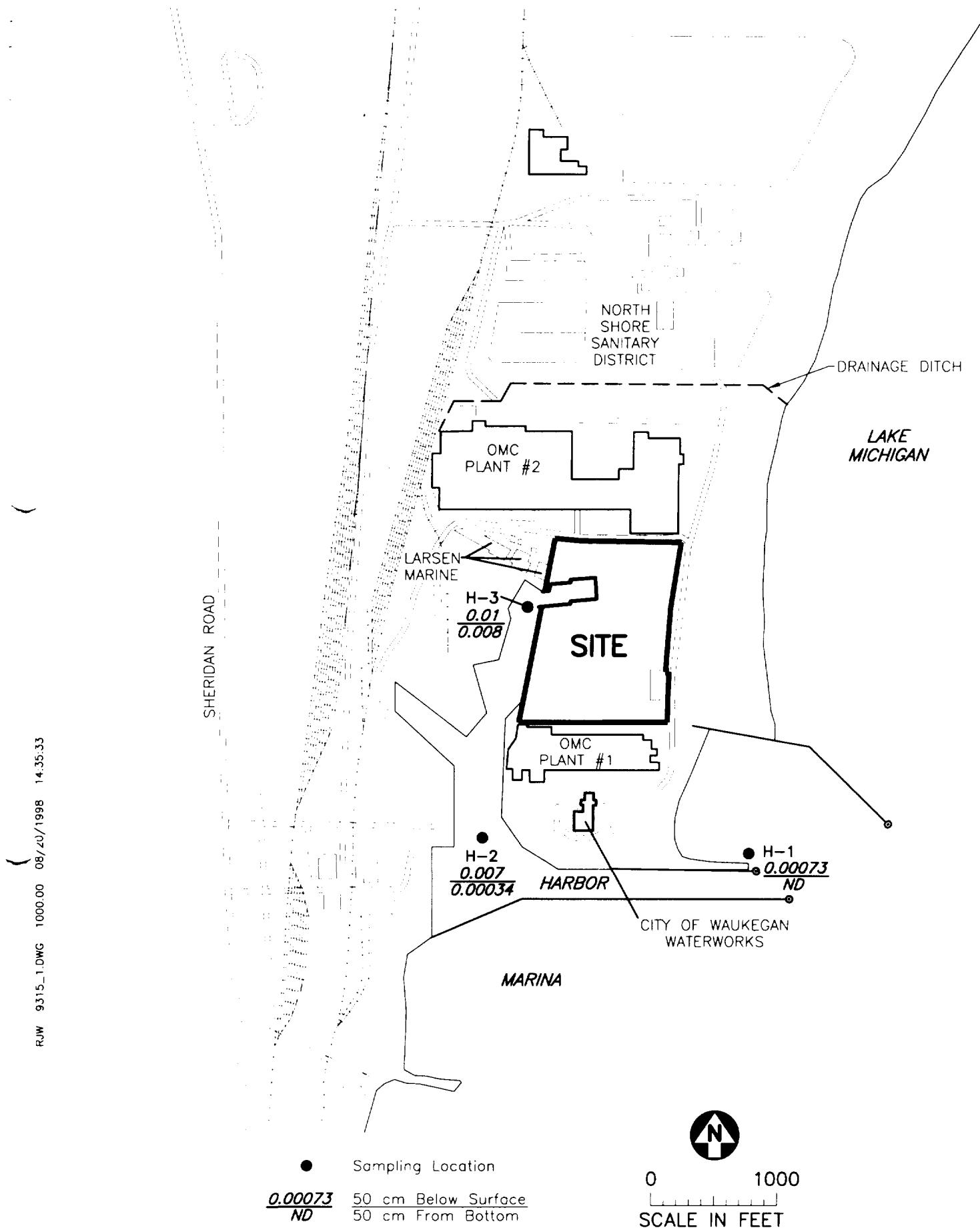


Figure 9
BENZENE CONCENTRATIONS
JULY 1998 SURFACE WATER SAMPLES – HARBOR
 (Concentrations In mg/L)
 Waukegan Manufactured Gas & Coke Plant Site

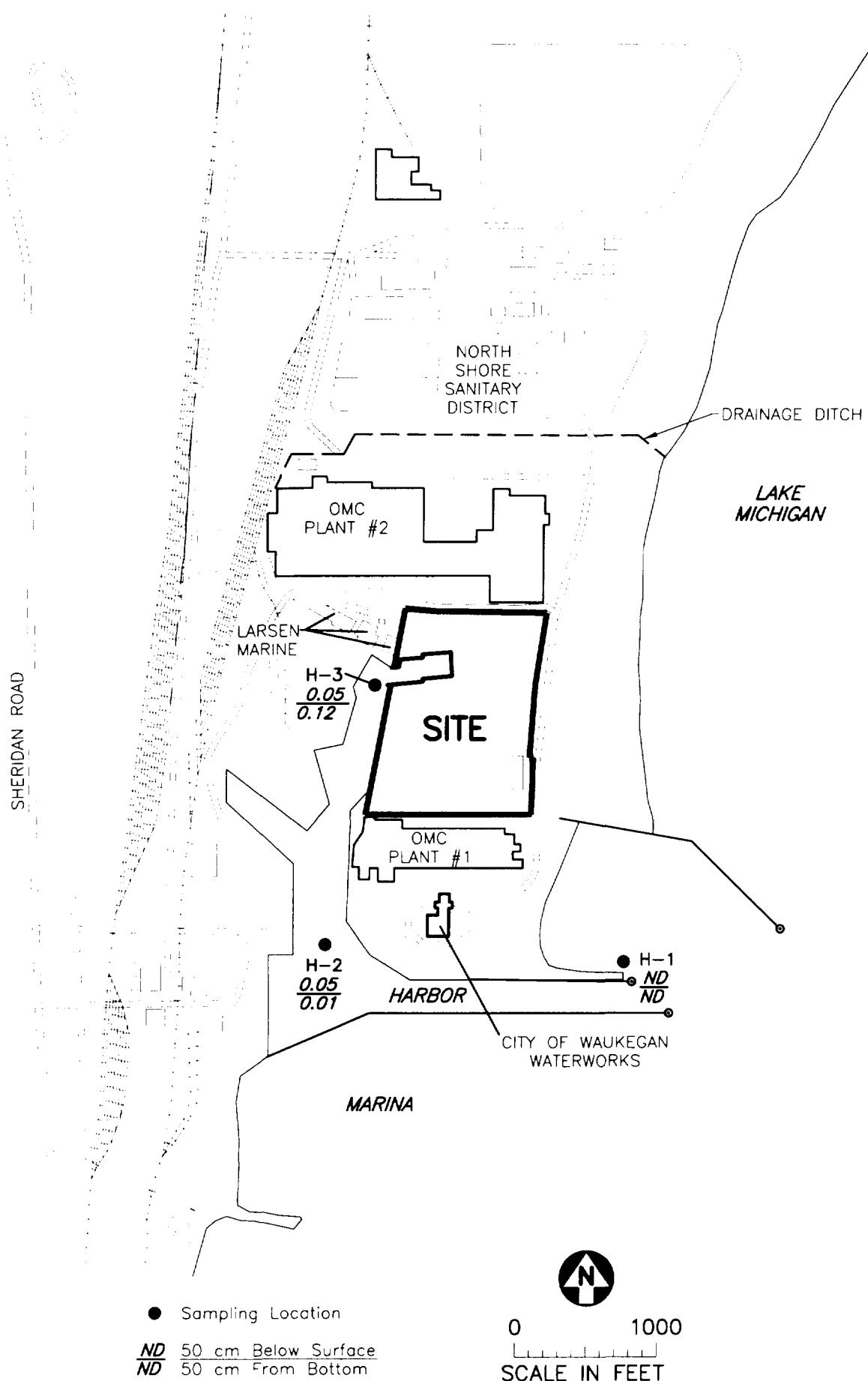


Figure 10
AMMONIA CONCENTRATIONS
JULY 1998 SURFACE WATER SAMPLES - HARBOR
(Concentrations In mg/L)
Waukegan Manufactured Gas & Coke Plant Site

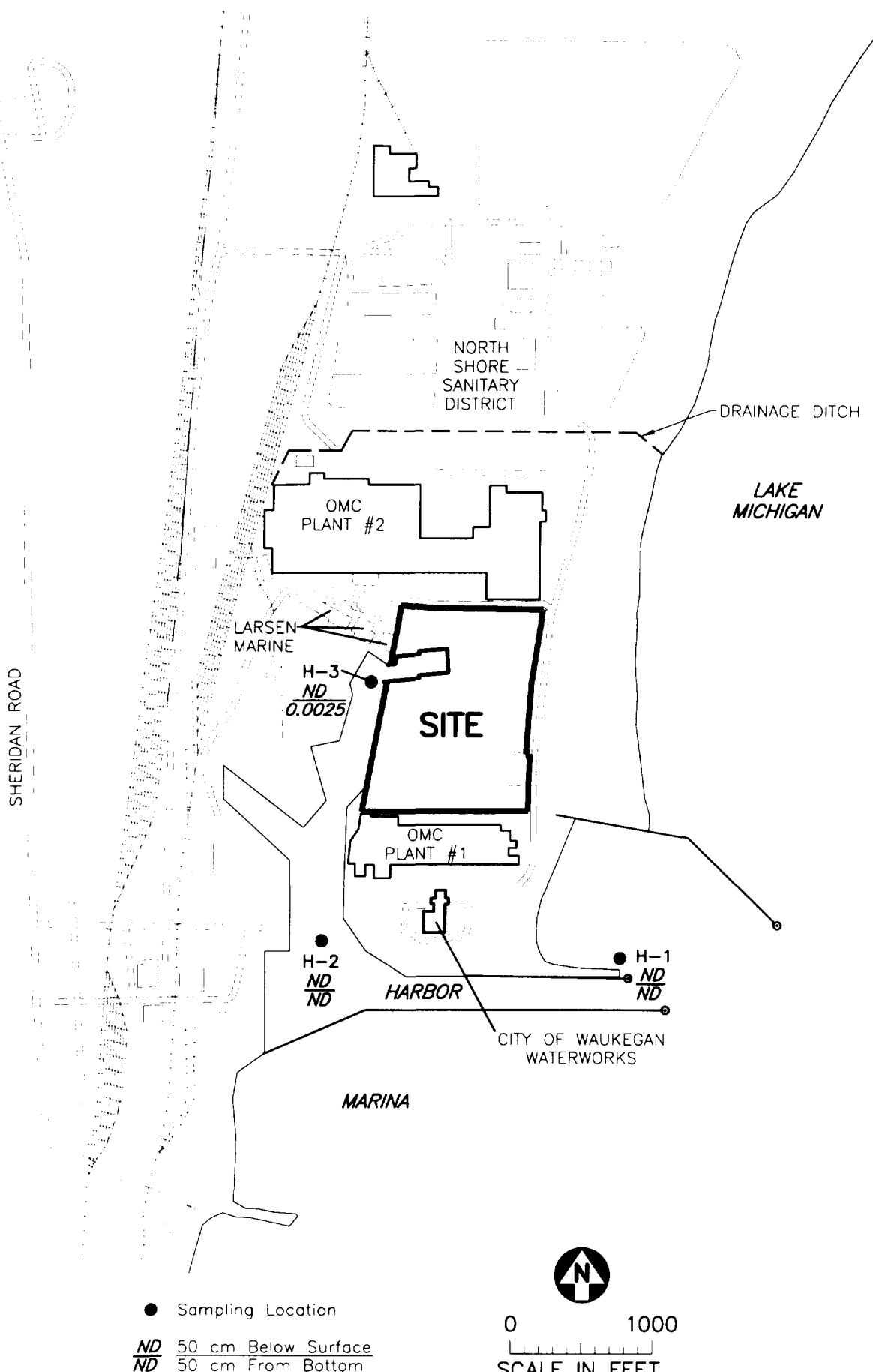
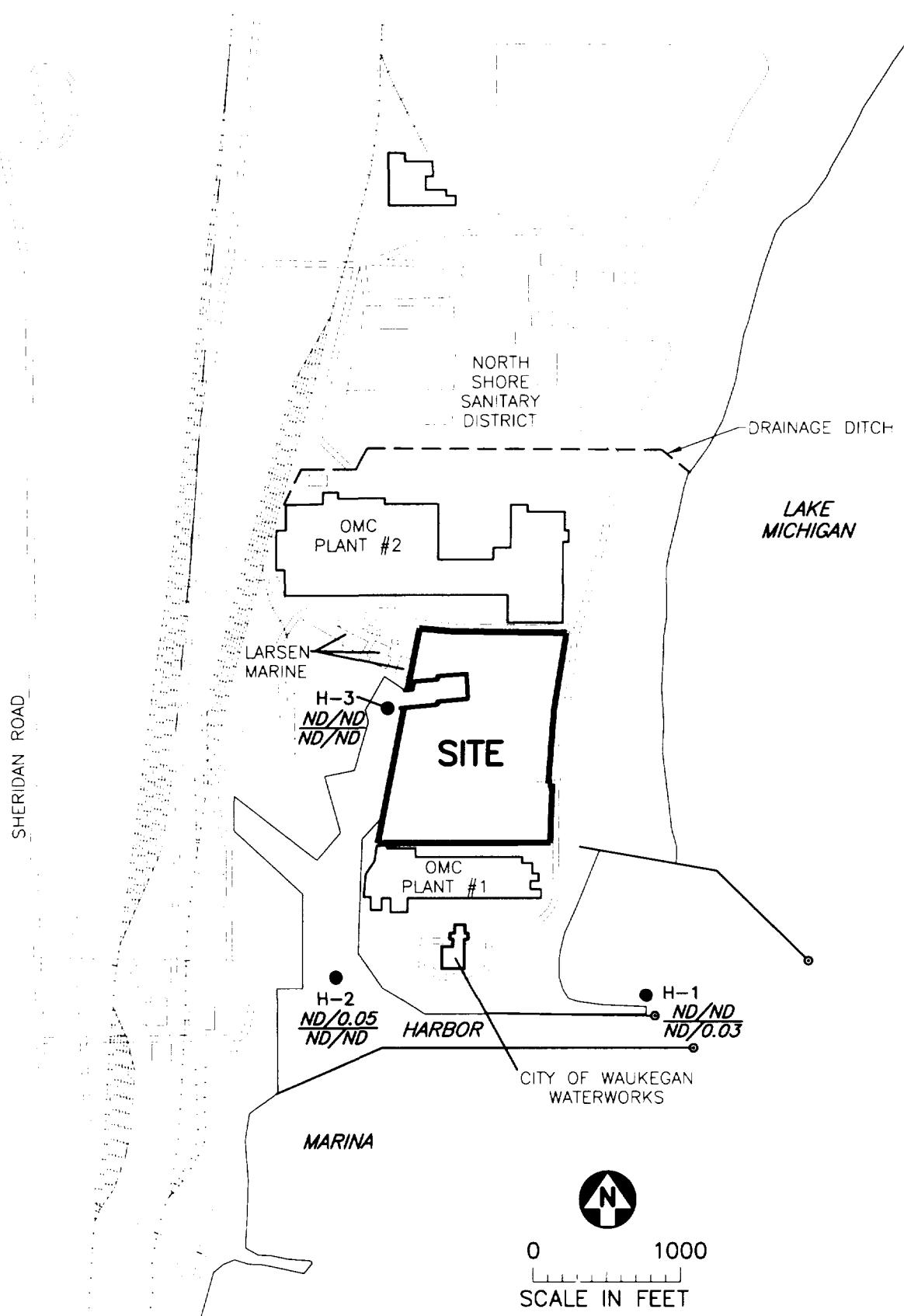


Figure 11
 ARSENIC CONCENTRATIONS
 JULY 1998 SURFACE WATER SAMPLES – HARBOR
 (Concentrations In mg/L)
 Waukegan Manufactured Gas & Coke Plant Site



● Sampling Location

$\frac{ND/ND}{ND/ND}$ (1)/(2) 50 cm Below Surface
 $\frac{ND/ND}{ND/ND}$ (1)/(2) 50 cm From Bottom

(1) Totals Determined By Summation Of Phenolic Compounds By Method 8270

(2) Totals Determined By 4AAP Analytical Method

Figure 12
 TOTAL PHENOLS CONCENTRATIONS
 JULY 1998 SURFACE WATER SAMPLES - HARBOR
 (Concentrations In mg/L)
 Waukegan Manufactured Gas & Coke Plant Site

FIELD DATA SUMMARY

Project: Waukegan Manufactured Gas & Coke Plant

Project number: 13/49-003JSL352

Field Staff: KSJ, JMF, DGG, MWI

Monitoring location	Date	Temp (°C)	Conductivity @ 25 °C	pH	Eh (mV)	Dissolved Oxygen (mg/L)	Water Depth (ft.)	Location Easting/Northing	Observations
SWT1-100A	6-30-98	12.0	292	7.41	76	11.21	3.8		Bottom- sandy w/ ripple marks
SWT1-100B	"	12.5	293	7.54	68	11.57	3.8		"
SWT1-50B	"	14.0	299	7.74	54	11.20	2.6		"
SWT1-50A	"	14.0	300	7.62	62	11.09	2.6		"
SWT1-150A	"	12.3	291	7.64	65	11.40	3.9		", bits of aquatic vegetation in water
SWT1-150B	"	12.9	292	7.72	61	11.31	3.9		"
SWT1-200A	"	12.6	288	7.71	63	11.43	3.2		Bottom- sandy w/ ripple marks
SWT1-200B	"	13.2	285	7.84	54	11.40	3.2		"
SWT1-250B	"	13.0	286	7.86	55	11.41	6.1		"
SWT1-250A	"	12.7	286	7.79	60	11.42	6.1		"
SWT2-50A	"	15.1	294	7.81	58	11.15	2.7		"
SWT2-50B	"	14.6	292	8.22	62	11.09	2.7		"
SWT2-100B	"	14.0	284	7.75	64	11.03	2.5		"
SWT2-100A	"	13.8	291	7.80	62	10.80	2.5		"
SWT2-150B	"	13.4	288	8.04	64	11.13	2.8		"
SWT2-150A	"	13.9	289	7.78	65	10.57	2.8		"
SWT2-200A	"	14.8	290	7.77	65	10.78	3.3		"
SWT2-200B	"	14.0	289	7.83	65	11.07	3.3		"
SWT2-250B	7-1-98	17.8	283	7.73	79	9.82	5.2		"
SWT2-250A	"	17.7	288	7.97	57	9.77	5.2		"
SWT3-50A	"	18.3	301	7.83	61	9.52	2.7		"
SWT3-50B	"	18.6	260	7.83	62	9.38	2.7		"
SWT3-100A	"	18.3	284	7.82	62	9.68	3.9		"
SWT3-100B	"	18.9	284	8.02	49	9.60	3.9		"
SWT3-150A	"	19.0	301	8.04	48	9.38	3.5		"
SWT3-150B	"	19.6	296	8.06	47	9.35	3.5		"
SWT3-250B	"	20.0	284	8.08	46	7.08	4.8		"
SWT3-250A	"	19.5	287	7.97	55	9.72	4.8		"
SWT3-200A	"	20.3	293	8.00	53	9.35	3.7		"
SWT3-200B	"	21.1	285	8.10	47	9.30	3.7		"
SW-1NA	"	19.3	287	7.95	59	9.56	4.7	0432876 / 4690462	"
SW-1NB	"	19.1	281	8.12	57	9.54	4.7		"
SW-2NA	"	20.4	291	7.86	65	9.30	4.1	0433061 / 4691229	"
SW-2NB	"	20.7	291	7.97	59	9.24	4.1		"
SW-4NA	"	19.4	290	7.99	63	9.52	9.3	0433970 / 4694345	", some aquatic vegetation on bottom in clumps
SW-4NB	"	19.2	276	8.06	60	9.53	9.3		"
SW-1SA	7-2-98	18.7	290	7.62	107	8.94	5.1	0432009 / 4689512	Bottom- sandy w/ ripple marks
SW-1SB	"	18.4	288	7.77	80	9.13	5.1		"
SW-3NA	"	17.5	288	7.89	69	10.15	2.1	0433319 / 4691860	"
SW-3NB	"	17.7	289	7.97	63	10.10	2.1		"
SW-6NA	"	20.5	297	7.86	66	9.01	1.8	0433779 / 4692919	"
SW-6NB	"	21.3	296	8.04	56	8.87	1.8		"
SW-5NA	"	16.1	287	8.07	59	8.07	6.5	0433916 / 4696142	"
SW-5NB	"	16.6	288	8.15	54	8.15	6.5		"
H-1B	"	15.6	288	7.95	67	9.84	18.0	0432917 / 4690251	", aquatic vegetation caught in tubing
H-1A	"	17.1	296	7.82	68	10.03	18.0		"
H-2B	"	15.9	288	7.87	72	8.58	25.0	0432277 / 4690303	silty sand bottom
H-2A	"	18.7	296	7.23	71	8.57	25.0		"
H-3A	"	18.4	297	7.11	69	7.94	21.0	0432387 / 4690841	"
H-3B	"	17.3	297	7.17	75	8.05	21.0		"